



Intergovernmental relations for public health adaptation to climate change in the federalist states of Canada and Germany

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ABSTRACT

Climate change is a significant threat to public health, and governments at all scales will need to adapt to protect the health of their populations. The impacts of climate change are highly localized and thus federal systems theoretically have the inherent advantage of allowing for regional diversity and policy experimentation in adaptation. However, there are also higher levels of conflict and stalemates in federal systems than in unitary systems, complicating intergovernmental relations and coordination necessary for public health adaptation. We examine how intergovernmental dynamics are patterned across national, regional and local levels of government for public health adaptation to climate change, drawing upon semi-structured interviews (n = 28) in comparative embedded case studies of Canada and Germany. We find that coordination between levels of government specifically for climate change and health is rare, but climate change issues are occasionally discussed through working groups or through existing methods of public health coordination. These findings have implications for national and regional governments in federal systems seeking to enable sub-national public health adaptation to climate change and create synergies between levels of government.

1. Introduction

The current and projected health impacts of climate change are well established in the scientific literature: morbidity and mortality related to extreme weather events (e.g., heat waves, floods, storms), infectious diseases associated with food and water contamination and changing vector biology and range, respiratory and cardiovascular illness related to declining air quality, and allergic symptoms associated with increased allergen production (Smith et al., 2014). Nonetheless, public health and health services are often overlooked in climate change adaptation research and planning (McMichael et al., 2009; Hess et al., 2012; Lesnikowski et al., 2011). Adapting to the health impacts of climate change is a challenge for public health officials, decision makers

and practitioners (Costello et al., 2009); public health institutions at all levels of government (e.g., national, regional², local) will need to adjust their practices to prepare for climate change (Hess et al., 2012; Austin et al., 2016; Watts et al., 2015) and coordinate between levels for effective public health adaptation (Bowen et al., 2013). Isolated approaches are insufficient to address complex environmental and social determinants of health where multiple levels of government are responsible for different aspects of public health issues (Fierbeck, 2010) and need to cooperate across these levels (Egeberg and Trondal, 2016). Without coordination, adaptation risks redundancy, fragmentation, or being maladaptive (Magnan et al., 2016).

Adaptation studies typically examine one level of government, without considering interactions (i.e., intergovernmental relations) or

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¹ www.trac3.ca.

² In this paper we follow Marks et al.'s (2008)– definition of regional government: “a coherent territorial entity situated between local and national levels with a capacity for authoritative decision making” (p. 113) (i.e., Canadian provinces and territories, German *Länder*)

coordination between levels (Koch et al., 2007; Henstra, 2017). In the past decade, studies have begun to examine the multi-level dimension of adaptation and interactions between governments (e.g., Bauer and Steurer (2014), Keskitalo (2010a), Urwin and Jordan (2008)). For example, Fidelman et al.'s (2013) study of multiple governmental levels of adaptation in the Great Barrier Reef region of Australia finds that the federal government provides funding to some local governments for assessing risks and developing action plans, and that the state government assists the local level by providing guidance and downscaled climate change projections.

Despite the regional level's pivotal role in adaptation (Farber, 2011; Bierbaum et al., 2013) and increasing policy authority over time (Hooghe et al., 2016), it has received little attention in adaptation studies relative to national and local governments (Dannevig and Aall, 2015; Aylett, 2015), with notable exceptions (e.g., Hanssen et al. (2013), Bauer and Steurer (2014)). This gap is most obvious in federal systems which have some constitutionally defined level of dispersion of authority from centralized to regional governments. In federal systems, regional governments have the jurisdictional mandate to hold a substantial role in adaptation planning and policy, unlike unitary countries where such responsibilities are often the role of national governments (Keskitalo et al., 2012). This is particularly true for policy issues such as health care and public health that are typically the responsibility of regional governments in federal systems (Blank and Burau, 2014). Federalism has the advantage of allowing for regional diversity and experimentation in adaptation responses, and having regional governments with the authority to facilitate adaptation at the local-level (Clar and Steurer, 2014). Intergovernmental relations and coordination for public health adaptation, however, are theoretically more challenging in federal than in unitary systems, considering both a regional level with significant or primary policy authority in health (Blank and Burau, 2014) and that adaptation to unprecedented levels of climate change is a new and complex policy issue. Several studies have examined the differences between unitary and federal systems for adaptation planning (Austin et al., 2016; Glicksman, 2010; Bauer et al., 2012), although it is unclear from the literature what implications *different types* of federal systems will have for adaptation.

This research focuses on the role of federalism and intergovernmental relations across levels of government in public health adaptation to climate change and asks: How are top-down and bottom-up intergovernmental dynamics patterned in different types of federal systems to enable public health adaptation at sub-national levels? We focus our analysis on formal and informal interactions driven from both the top-down by national and regional actors and from the bottom-up by local actors, along with formalized mechanisms for coordination (e.g., committees, working groups). This research draws upon a comparative embedded case study of the Canadian province of Quebec and German *Land* Baden-Württemberg. Canada and Germany are both high-income countries but have different types of federalism.

2. Background information: Canadian and German public health systems

Health policy in Canada is decentralized to the provinces and territories (Banting and Corbett, 2002), with Section 92(13) of the *Constitution Act* and subsequent legal interpretations recognizing public health as a primarily provincial jurisdiction (Wilson, 2004). There is a general recognition at all levels of government that coordination is needed for public health, but coordination is more difficult to achieve in Canada than in other federal states because constitutional law protects provincial jurisdictional autonomy from federal encroachment (Bakvis and Brown, 2010; Wilson, 2004). At the federal level, Health Canada and the Public Health Agency of Canada (PHAC) share health responsibilities. In Quebec, the *Ministère de Santé et Services Sociaux* (MSSS) [Ministry for Health and Social Services] is responsible for health issues. Its scientific arm, the *Institut national de santé publique du Québec*

(INSPQ) [Quebec National Institute for Public Health], supports the MSSS and Public Health Directorates by conducting public health research and disseminating knowledge (Bernier, 2006). Quebec is known for its progressive social and public health policies (Bernier, 2006) and was an early adopter of climate change adaptation measures in the health sector (Austin et al., 2015; Gosselin et al., 2011).

Unlike other aspects of health policy in Germany, such as health financing, the *Länder* have primary policymaking authority in public health (Mätzke, 2013; Banting and Corbett, 2002). At the federal level the *Bundesministerium für Gesundheit's* (BMG) [Ministry of Health] has primary health responsibilities (Mätzke, 2013). The Robert Koch Institute (an organization of the BMG), supports the BMG's public health activities with disease identification, research, surveillance and prevention. The *Umweltbundesamt* (UBA) [German Environment Agency] also works on environmental health issues such as climate change and health, and is an agency of the *Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit* (BMUB) [Ministry for the Environment, Nature Conservation, Building and Nuclear Safety]. In Baden-Württemberg the *Landesgesundheitsamt* [State Public Health Office] is responsible for advising Local Public Health Offices on public health issues, and is an agency of the *Ministerium für Soziales und Integration* [Ministry of Social Affairs and Integration].

3. Conceptual framework

3.1. Federalism

Federalism is intended to ensure power sharing and safeguard liberal democracies, while protecting sovereignty and regional diversity, and allowing for variations in local policy design and implementation (Fenna, 2012; Elazar, 1987). As such, federalism provides an opportunity structure for climate change adaptation policy experimentation³ and learning, where regional climate change vulnerabilities are addressed at the sub-national scale and policy innovation is stimulated between and within regions. Federalism involves some combination of self-rule and shared rule (Elazar, 1987). Self-rule refers to independence of the regional government from the national government's authority and the scope of the regional government's decision-making authority, while shared rule refers to the regional government's influence on national decision-making (Hooghe et al., 2016). By this very definition of self-rule and shared rule, "federalism allows flexible solutions to complex situations of overlapping jurisdiction and contested sovereignty" (Hueglin and Fenna, 2015).

The interdependent and over-lapping jurisdictions associated with complex intergovernmental relations in federations contributes to disproportionate bureaucratic and executive control, and limits government accountability to the public (Simeon and Swinton, 1995). In addition, others argue federalism inherently means weak government because power is split between federal and regional governments and no one government is capable of taking strong action (Burgess, 2006; Dicey, 1893). In the context of adaptation to climate change, sub-national governments' progress on adaptation in federal systems tends to be more unequal, with some sub-national jurisdictions pushing ahead while others lag behind (Keskitalo, 2010b; Austin et al., 2015).

Federal systems can be classified by their type of federalism, federation structure and intergovernmental relations (Table 1). Federal systems can be legislative or administrative, or in other words, they can legislate to divide either policy areas (i.e., legislative federalism) or roles within policy areas (i.e., administrative federalism) (or some combination of both). The structure of federations can alternatively be categorized as divided or integrated systems (Hueglin and Fenna, 2015). This type of classification can be idealized as dividing

³ Policy experimentation refers to the testing of innovative policies or programs, which may then be replicable in other jurisdictions.

Table 1
Features of Canadian and German Federalism.

Feature	Canada	Germany
Type of Federalism (Hueglin and Fenna, 2015)	<i>Legislative Federalism</i> - Policy areas are divided between federal and provincial governments - Each level retains the powers of legislation, implementation and administration within their respective policy jurisdictions	<i>Administrative Federalism</i> - Most policy areas are shared between federal and <i>Länder</i> governments for joint responsibility, but roles are divided - Federal government holds broad policy-making authority, sub-national government executes and administers national policies
Federation Structure (Hueglin and Fenna, 2015; Watts, 1999; Bolleyer and Börzel, 2010; Hooghe et al., 2008)	<i>Divided System</i> - Provinces do not have a formal role in federal decision-making - Emphasis is placed on provincial autonomy - Loosely coupled, high levels of self-rule	<i>Integrated System</i> - <i>Länder's</i> involvement in federal decision-making is emphasized and institutionalized in the <i>Bundesrat</i> (second chamber) - Tightly coupled, high levels of shared rule
Intergovernmental Relations (Hueglin and Fenna, 2015; Cameron and Simeon, 2002; Poirier and Saunders, 2015; Bolleyer and Börzel, 2010; Lang, 2015; Watts, 1999; Adam et al., 2015; Benz, 2007)	<i>Federal-Provincial Diplomacy</i> - No constitutional mechanisms for intergovernmental interactions - Resembles diplomatic relations between nation states - Increasingly being informed by collaborative federalism practices - Relationships can be characterized as non-hierarchical, interdependent and collaborative - Emphasis is placed on provincial autonomy - Largely informal, relying upon networks of intergovernmental meetings and relationships between civil servants of different levels of government	<i>Cooperative Interlocking</i> - Defining characteristic is cooperation between the federal and <i>Länder</i> governments - All federal laws must be considered by the <i>Bundesrat</i> which includes representatives from each <i>Land</i> - Intergovernmental relations take place through both formal institutions and informal interactions between political and administrative officials - Increasingly using policy competition as a mode of governance

governments' power into 'watertight compartments' or being 'co-ordinative in nature' (Maioni, 2002), although in reality the division of powers between levels may have more spillovers than planned during the development of constitutions (Hueglin and Fenna, 2015). Intergovernmental relations refer to the formal or informal relationships between elected officials or civil servants in different levels of government (Wright, 1974) and are discussed in more detail in the next section.

3.2. Intergovernmental relations for climate change adaptation in two federal systems

Intergovernmental relations can be a considerable challenge in federal systems (Table 1) (Fenna, 2012; Phillimore, 2013). Intergovernmental relations can include the relationships between any levels of government, including the local level. They can be formal or informal, though studies on climate change adaptation often focus on formal interactions (Henstra, 2017; Fidelman et al., 2013). Formal mechanisms for intergovernmental relations include constitutional, statutory, official and expert committees, executive meetings between the head of state and regional government leaders, and other formal meetings (Poirier and Saunders, 2015; Hueglin and Fenna, 2015; Phillimore, 2013). For example, the German federal government frequently uses institutionalized planning committees to coordinate with *Länder* governments (Benz, 2000).

Yet in many contexts, informal institutions shape political and administrative behavior and outcomes (Bolleyer and Börzel, 2010; Klein and Juhola, 2018; Chisholm, 1992; Steurer and Clar, 2018), and therefore these informal rules of the game also need to be taken into account in order to provide a more complete explanation of empirical phenomena (Helmke and Levitsky, 2004). Informal mechanisms meanwhile include emails, phone calls, informal meetings, political party connections, and long-term interactions, which can later become formalized (Poirier and Saunders, 2015; Phillimore, 2013). Informal and personal connections play a pivotal role in effective intergovernmental relations, requiring attention to trust, mutual respect, and willingness to engage and cooperate (Poirier and Saunders, 2015; Phillimore, 2013).

Intergovernmental relations are rarely formally outlined in

constitutions and so they evolve to meet cooperation and coordination needs (Hueglin and Fenna, 2015). Coordination can be used in inter-governmental relations to ensure there is synergy between exclusive but related policy areas of respective jurisdictions (Peters, 2015), as well as to establish roles and responsibilities in shared policy areas to reduce duplication (Poirier and Saunders, 2015). Policy coordination can be contentious, especially where sub-national governments have high levels of self-rule and prioritize their autonomy, as in Canada (Hooghe et al., 2008; Hueglin and Fenna, 2015). Federations need to achieve at least a minimum level of essential policy coordination to ensure nationwide policy objectives are met (Bakvis and Brown, 2010), such as climate change adaptation priorities.

Intergovernmental policy coordination (or vertical coordination) can be achieved through three modes of governance: collaboration, coercion (hierarchy) or competition (economic or policy) (Benz and Eberlein, 1999; Benz, 2007). Peters and Pierre (2001) argue intergovernmental relations in general are shifting from 'command and control' or coercion to governing through enabling, where upper-level governments define objectives and provide resources. This is in line with climate change adaptation studies suggesting that governing through enabling is most common by national governments in federal systems (Kern and Alber, 2008; Henstra, 2015). In Germany, early adaptation efforts such as the Adaptation Action Plan (German Federal Government, 2011) have been cooperative initiatives between the federal and *Länder* governments by design (Westerhoff et al., 2010), while in Canada adaptation has been referred to as a spontaneously emerging, loosely connected 'multi-level mosaic' (Dickinson and Burton, 2011; Austin et al., 2015). In both contexts, the literature suggests that the relationship between federal and regional governments for climate change adaptation follows theoretical patterns of intergovernmental relations: intergovernmental cooperation in Germany and federal-provincial diplomacy in Canada, resembling relations between sovereign nations (Table 1). Though intergovernmental relations literature provides theoretical grounding for how adaptation could be occurring between federal and regional governments in different federal systems, the federal-local or regional-local relationship is more difficult to theorize because it is context-specific, path dependent and often not constitutionally defined (Phillimore, 2013; Scharpf, 1978).

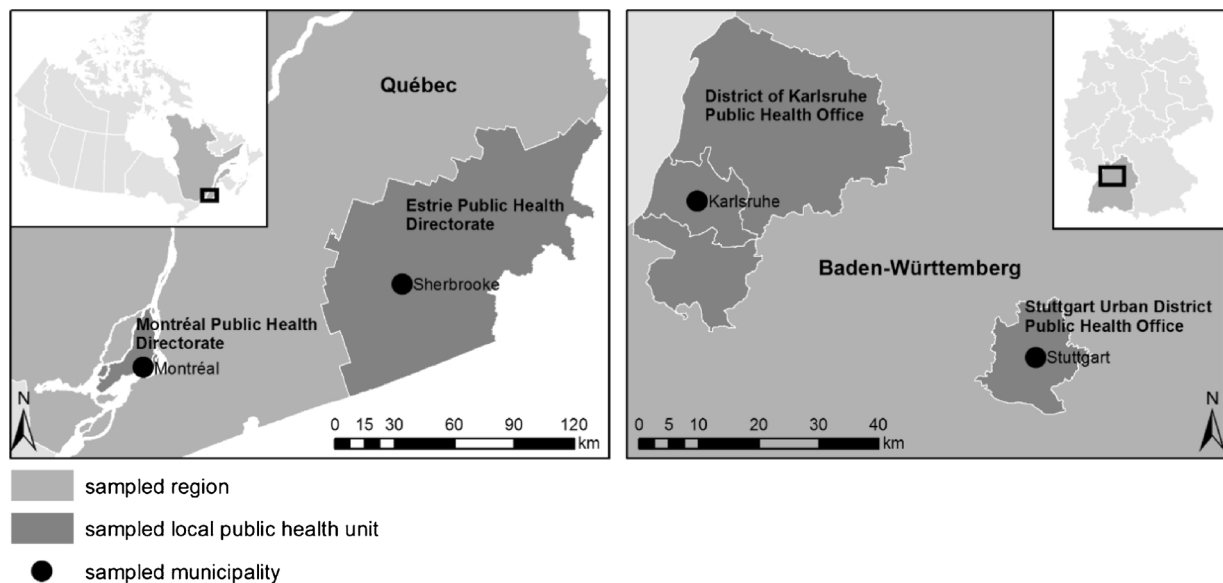


Fig. 1. Maps of nested case studies in Canada (left) and Germany (right). Map source: first author. Data source: Bundesamt für Kartographie und Geodäsie (2017), Statistics Canada (2011, 2015).

We thus expect to find greater formalization of coordination and intergovernmental relations for public health adaptation in Germany than in Canada, and likewise, greater top-down intergovernmental relations in Germany while greater bottom-up intergovernmental relations in Canada. In short, we expect that institutional structure matters for coordination and intergovernmental relations for public health adaptation in federal systems.

4. Methodology

In this paper, we examine how intergovernmental relations are occurring between all levels of government (federal, regional, local public health authorities, and municipal governments) for public health adaptation to climate change in Canada and Germany – two federal systems that are, in many respects, on opposite ends of the federalism spectrum.

4.1. Case selection

We conducted comparative nested case studies using semi-structured interviews (Fig. 1). Canada and Germany were selected as relatively comparable high-income countries with federal, decentralized administrative structures (Table 2), but different institutional arrangements and types of federalism (Table 1). Quebec and Baden-Württemberg were positively selected as the regional case study from each country respectively, based on their role as regional-scale leaders in public health adaptation (Austin et al., 2015; Umweltbundesamt, 2014). Within each regional jurisdiction, two local jurisdictions were selected to explore local variation. The first was each region's largest city by population, and the second was another city in the region that had made significant progress on adaptation (e.g., development of a comprehensive adaptation plan). We also sampled the local health authority or equivalent surrounding the city if it was not part of the city government. In Quebec, the local case studies selected were the City of Montreal and its encompassing Public Health Directorate of Montreal and the City of Sherbrooke and its encompassing Public Health Directorate of Estrie. In Baden-Württemberg, the local case studies selected were the City of Stuttgart and the City of Karlsruhe, and the encompassing District of Karlsruhe Public Health Office. The City of Stuttgart's local public health office is part of the urban district. The City of Karlsruhe is unusual because it has a Community Health Promotion

Section within the Environment Department that also works on health promotion alongside the Karlsruhe District Local Public Health Office, whereas normally cities are not responsible for health promotion. See Appendix A for background information on each jurisdiction's adaptation plan or strategy.

4.2. Data collection and analysis

We conducted 28 semi-structured interviews from June to October 2016 with key informants from the Canadian and German federal governments, Quebec and Baden-Württemberg regional governments, the municipal governments of Montreal, Sherbrooke, Stuttgart and Karlsruhe, their encompassing local health authorities Montreal Public Health Directorate, Estrie Public Health Directorate, and the Karlsruhe county public health office, and relevant NGOs, city networks or academics (Table 3).

The interview questions covered broad themes to assess how intergovernmental relations for public health adaptation were taking place, including top-down and bottom-up influence for adaptation, coordination or collaboration between levels for adaptation, and jurisdictional roles and responsibilities for adaptation. Additional interview questions sought to clarify the jurisdiction's administrative structure, adaptation progress, policy capacity for adaptation, the role of non-governmental actors, and general questions regarding the interviewee's position and program areas.

Interviews were conducted in English, French or German based on the preference of the interviewee. Interviews in German were conducted with the assistance of an interpreter. Interviews were primarily done in person; two were conducted by telephone or Skype. Research ethics approval was obtained from McGill University for this study prior to commencing interviews.

Interviews were audio-recorded, transcribed, and coded using Atlas.ti (version 7.5) software. We used deductive coding methods to analyze the interviews for discussion of intergovernmental relations and federalism, coding top-down or bottom-up interactions for public health adaptation across levels of government, and coordination or disconnects between levels of government. We then conducted inductive coding – seeking to 'hear what was said' – by examining repeating ideas to identify themes discussed by the interviewees that were not considered a priori by the research team (Auerbach and Silverstein, 2003).

Table 2
Administrative, Demographic, Economic and Public Health System Contextual Information.

	Canada	Germany
Number of Constituent Units	13 National (provinces and territories) Quebec (administrative regions) ^f Direction de Santé Publique de Montreal (municipalities)	16 National (<i>Länder</i>) Baden-Württemberg (regional districts and urban districts ^g) Stuttgart Urban District Public Health Office (municipalities)
Population (thousands) ^{a,b,c}	89 Direction de Santé Publique de l'Estrie (municipalities) National Quebec Direction de Santé Publique de Montreal City of Montreal Direction de Santé Publique de l'Estrie City of Sherbrooke National Quebec	33 District of Karlsruhe Public Health Office (municipalities) National Baden-Württemberg Stuttgart Urban District City of Stuttgart District of Karlsruhe City of Karlsruhe National Baden-Württemberg
GDP per Capita (USD) (in 2014) ^d	33476.7 7903 1886.5 1649.5 310.7 154.6 42,353 34,313	82175.7 10879.6 623.7 623.7 2762 307.8 42,450 48,609
Federal government public health responsibilities and authority	Maintains fiscal and some political power to influence provincial health systems. Has some legislative authority for public health if: issues have intra- and extra-provincial implications; provinces are not able to regulate; and, there will be spillovers if one province does not address the issue. (Wilson, 2004; Maioni, 2002)	Shares responsibility with the <i>Länder</i> government for setting overall health policy goals and general guidelines, and ensuring adherence to the legal framework. In public health conducts data collection, research, documentation and licensing of medicinal products. (Wätzke, 2013; Wassenar, 2002)
Regional governments' public health responsibilities and authority	Have primary jurisdiction over all public health issues in the province. (Wilson, 2004)	Share responsibility with the federal government for setting overall health policy goals and general guidelines, and ensuring adherence to the legal framework. Have primarily policymaking capacity in public health in the <i>Länder</i> . (Wassenar, 2002; Banting and Corbett, 2002; Mätzke, 2013)
Local public health authorities' responsibilities and authority ^e	Responsible for keeping the public informed, monitoring potential health threats, taking measures to protect health, preparing a regional public health action plan, and maintaining expertise in preventative health and health promotion. Quebec (2016)	Responsible for overall health planning and reporting, management of municipal health conventions, prevention and control of communicable diseases, protection against harmful environmental influences, and specific tasks such as water monitoring, child and adolescent health, hygienic monitoring of facilities and medical certificates. (Landesgesundheitsamt Baden-Württemberg, n.d)

^a Canada (all levels) population data source: Statistics Canada (2016).

^b Germany (federal level) population data source: Statistisches Bundesamt (2015).

^c Germany (sub-national levels) population data source: Statistische Landesamt Baden-Württemberg (2015).

^d GDP per Capita data source: OECD (2014).

^e For Quebec and Baden-Württemberg, respectively, only. Local public health authorities' responsibilities vary between provinces or between *Länder*.

^f Each administrative region in Quebec has its own Public Health Directorate.

^g Each regional district and urban district in Baden-Württemberg has its own Public Health Office.

Table 3
List of interviewees by jurisdiction.

Level	Canada	Germany
<i>Federal</i>	- Health Canada - Public Health Agency of Canada - Environment and Climate Change Canada	1 German Environment Agency 2 German Meteorological Office 3 Robert Koch Institute
<i>Regional</i>	Quebec 4 Quebec National Institute for Public Health 5 Ministry for Health and Social Services 6 Ministry of Sustainable Development, Environment and the Fight Against Climate Change	Baden-Württemberg 4 State Public Health Office 5 Ministry of the Environment, Climate Protection and the Energy Sector
<i>Local Case Study #1</i>	Montreal 6 Montreal Public Health Directorate 7 City of Montreal 8 City of Montreal	Stuttgart 6 Stuttgart Public Health Office 7 Stuttgart Public Health Office 8 City of Stuttgart
<i>Local Case Study #2</i>	Estrie/Sherbrooke 10 Estrie Public Health Directorate 11 CIUSSS de l'Estrie – CHUS 12 City of Sherbrooke	Karlsruhe 9 Karlsruhe Public Health Office 10 City of Karlsruhe 11 City of Karlsruhe
<i>Non-Governmental Key Informants</i>	13 Conseil-Régional Environnement Montréal 14 Ouranos	12 University of Stuttgart 13 Climate Alliance 14 South German Climate Office

5. Results

5.1. Intergovernmental relations for public health adaptation in Canada

5.1.1. Top-down Canadian government coordination and interactions

At the federal level in Canada, both Health Canada and PHAC have been active on climate change and health. Health Canada engages with some local public health authorities on pilot projects such as the Heat Alert and Response Systems (HARS) projects and a syndromic surveillance system for extreme heat in the City of Ottawa. Health Canada also works with some local public health authorities to facilitate the development of climate change and health vulnerability assessments (Berry and Richardson, 2016). In Canada, the local level⁴ is within the jurisdiction of the provinces, but federal government agencies such as Health Canada have developed strong relationships with both the provincial and local levels: “we’ve been able to do pilots on extreme heat with cities, we’ve been able to facilitate their adaptation and learn from what they do when they develop heat alert and response systems” (interviewee, Health Canada). Through these ongoing projects and collaborations, Canadian federal agencies such as Health Canada and PHAC interact informally with various regional and local public health authorities on a regular basis, sometimes daily: “We’re all on first name terms” (interviewee, PHAC).

The Pan-Canadian Framework on Clean Growth and Climate Change and its Working Group on Adaptation and Climate Resilience⁵ (co-chaired by one federal and one provincial government representative) is considered by federal and provincial government interviewees alike to be a step towards greater coordination and collaboration between the federal, provincial and territorial governments on climate change adaptation. Though the working group is not health specific, health is a stated priority area (Government of Canada, 2016a). The federal, provincial and territorial public health networks have several additional working groups and committees for coordination, including the Chief Medical Officers of Health, the Lyme Disease Surveillance Network, and the Committee on Health and Environment. Though none of these are climate change specific, climate change has been occasionally discussed in each, for example in presentations from

Health Canada or PHAC. PHAC also has formalized agreements for collaborations with sub-national partners, including on climate change adaptation projects. Despite several formalized mechanisms for coordination of public health activities where adaptation is sometimes discussed (Fig. 2a), health, and related adaptation considerations, are nonetheless considered to be firmly a provincial policy area:

“The federal [level] does not interfere in our provincial level actions. There are agreements. I know that work has been done in the context of certain projects. There are understandings, because, well, they have expertise on certain things, but there is no interference from the federal level [...] the health sector, it’s a provincial domain” (interviewee, MSSS).

The federal government provides funding for some provincial public health adaptation activities. For example, some of the INSPQ’s early work researching the health impacts of climate change in Quebec between 2000 and 2004 was funded by Health Canada (along with the MSSS and Ouranos – a regional climate change research consortium, funded in part by the Quebec government). The INSPQ frequently receives funding from the federal government in the form of research contracts for studies that could be generalizable to other parts of Canada. Health Canada provides funding to some local public health authorities for the development of vulnerability assessments or pilot projects, and otherwise on an ad hoc basis. For example, the Montreal Public Health Directorate received federal funding to develop, evaluate and test a heat alert system, and to conduct research on communication with vulnerable populations during heat waves. Federal government interviewees saw federal adaptation funding as seed money for measures that would otherwise be non-starters without it:

“because provincial and municipal governments don’t always have the additional resources to deal with these issues, the federal funding can really influence that and bring some of that extra seed money to the table” (interviewee, Environment and Climate Change Canada).

Health Canada has published several climate change and health guidelines including, for example, a series of extreme heat event guidelines and best practices guidebooks (Health Canada, 2012, 2011a, b, c), and conducts research to support sub-national public health adaptation. Health Canada held a climate change and health workshop in 2016 with provincial and territorial partners, and some local partners, to inform their own work on public health adaptation. PHAC conducts research, monitoring and surveillance of infectious diseases to inform their own activities on climate change and sub-national public

⁴ In this paper local level refers to both local health authorities and municipalities, unless otherwise specified.

⁵ At the time of interviewing, the Working Group was preparing its final report which was published in late 2016 (Government of Canada (2016b). Working Group on Adaptation and Climate Resilience: Final Report. Gatineau, QC: Government of Canada.

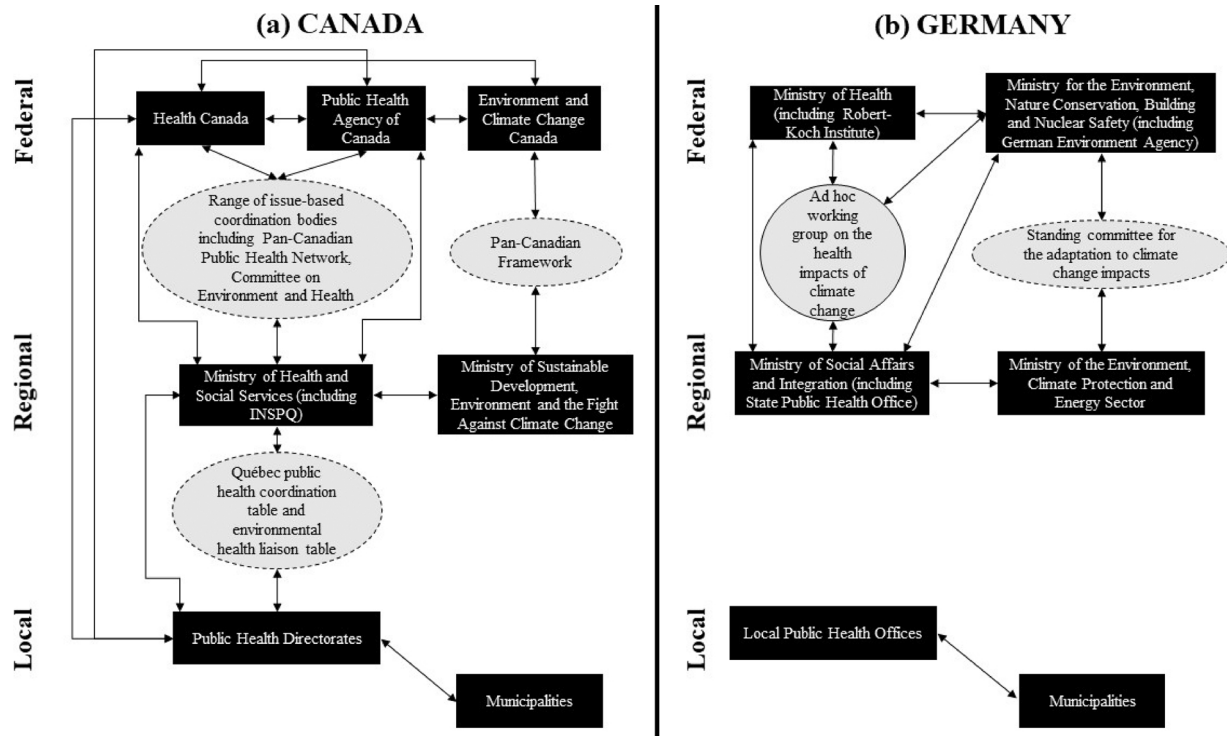


Fig. 2. Institutional map of coordination platforms and linkages for public health adaptation between levels of government in Canada (a) and Germany (b). Black rectangles refer to institutions and grey ovals refer to coordination platforms. Arrows refer to formal interactions for public health adaptation (e.g., formalized cooperation, pilot projects, agreements). Coordination platforms that are dedicated to both climate change and health have a solid outline and those that are either for climate change or health, not both (but may discuss both topics at times) have a dotted outline. This figure is the result of both key informant interviews and policy analysis.

health authorities. Health Canada and PHAC prepared or contributed to a series of national vulnerability assessments that are intended to support sub-national decision-making (Lemmen et al., 2008; Warren and Lemmen, 2014; Séguin, 2008).

Political changes in the Canadian case study shaped the interactions and possible mechanisms for coordination between the federal government and sub-national governments. Interviewees at all levels frequently described the recent Conservative government's terms in office (2006–2015) as a period when the federal level was not very involved in sub-national climate change adaptation activities:

“During seven to eight years it was just us. The federal level was pretty ‘up and down’. There was interest [in climate change adaptation] up until 2008, then when [Prime Minister] Harper came it was clear they were going to leave a lot” (interviewee, INSPQ).

Under the current Liberal government, the MSSS and INSPQ are in discussions to increase collaborations and projects for public health adaptation with the federal government, and there is a sense from governments at all levels there could be greater synergies between for public health adaptation to climate change.

5.1.2. Top-down Quebec Government coordination and interactions

In Quebec there is a well-established system of using public health coordination tables between the MSSS, the INSPQ and the Public Health Directorates (Fig. 2a). One of these thematic public health coordination tables is the *Table nationale de concertation en santé environnementale* [Québec environmental health liaison table] which meets three to four times per year and includes representatives from each Public Health Directorate. Approximately once per year the topic of climate change is raised in the environmental health liaison table. Mechanisms for bottom-up influence exist whereby the INSPQ will ask the Public Health Directorate representatives about their needs, present the INSPQ's planned upcoming work and request the Public Health Directorates'

approval for the planned work. In this way, the MSSS and INSPQ consider the Public Health Directorates equivalent to clients in their work on climate change adaptation. Provincial interviewees found the relationship with local public health authorities to be positive: “We have a lot of interest. There aren't any problems working with the [Public Health Directorates]. Since 2004 [the INSPQ] meets all the regions at least once per year to discuss climate change” (interviewee, INSPQ).

In 2015 the Quebec government released its *Plan National de Santé Publique 2015–2025* [National Public Health Plan], in which climate change, aging populations and the social inequalities in health were given as the three priority axes that all Public Health Directorates are required to include in their *Plans d'Action Régionale* [Regional Action Plans], in accordance with the *La Loi sur la santé publique* (LSP) [Quebec Public Health Act]. Public Health Directors can decide, however, how to include these issues in their plans, and retain their autonomy in decision-making. The mandate was welcomed by the Public Health Directorate interviewees in Montreal and Estrie who said it increased the prioritization of climate change and decisions to embark upon climate change adaptation activities within the Directorates. The provincial government sometimes also requires the Public Health Directorates to adopt intervention measures for the impacts of climate change laid out in guides, such as for flooding, heat or ragweed (*Groupe de travail ad hoc sur les inondations*, 2015), also under the LSP.

The INSPQ and MSSS provide funding on an ad hoc basis to Public Health Directorates from the Quebec Green Fund. For example, the Estrie Public Health Directorate received funding from the INSPQ to research methods for communicating with individuals with mental health disorders during heat waves. The *Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques* (MDDELCC) [Ministry of Sustainable Development, Environment and the Fight Against Climate Change] *Climat Municipalités* [Municipalities Climate] program additionally provides funding to

some municipalities to develop adaptation plans, but not to Public Health Directorates.

The INSPQ engages with Public Health Directorates on pilot projects such as a system for automatic alerts for vulnerable populations in the Montréal Public Health Directorate, and a pilot project with the Montreal Public Health Directorate for ragweed control measures. They have conducted other pilot projects on urban greening in Montreal and Quebec City. These pilot projects are intended to be generalizable to the entire province.

The INSPQ frequently develops targeted research and guidelines on climate change and health adaptation, sometimes in partnership with Ouranos, for the Public Health Directorates or municipalities (e.g., climate change and health vulnerability atlas, *Mon climat, ma santé* [My climate, my health] website). The INSPQ also developed an open source information and decision-support system called SUPREME (Surveillance and Prevention of the impacts of Extreme Meteorological Events on public health) for the entire province. The system includes functions for data acquisition and integration, risk analysis and alerts, cartographic applications and climate change and health information (Toutant et al., 2011).

5.1.3. Local public health perspectives and bottom-up interactions

Local Public Health Directorate interviewees' experiences working with the federal and regional governments varied between the larger Montreal Public Health Directorate and smaller Estrie Public Health Directorate. The Montreal Public Health Directorate has a high level of research capacity for climate change and health issues, and strong ties with both the INSPQ and Health Canada on adaptation, in part through past pilot projects. The Montreal Public Health Directorate's work on public health adaptation has been scaled up in the past. For example, following the development and implementation of Montreal's Heat Alert and Response Strategy, the Montreal Public Health Directorate conducted presentations on their experiences for other agencies, such as Health Canada. However, the interviewee from the Montreal Public Health Directorate expressed greater interest in being provided with funding for their own initiatives rather than being required to participate in province-wide measures such as the provincial ragweed program. Currently the Montreal Public Health Directorate struggles to get its ideas for adaptation projects off the ground because of a lack of buy-in and financial support from upper-level governments relative to the City of Montreal:

"You will see, the City of Montreal has the climate change adaptation fund from the Quebec government for infrastructure, for all types of things, then there's the Federation of Canadian Municipalities that comes from the federal government. There are funds, but more for city functions than public health" (interviewee, Montreal Public Health Directorate).

Interviewees from the Estrie Public Health Directorate, meanwhile, did not feel very involved in the federal or provincial governments' public health adaptation activities. One interviewee said it is unclear what kind of support Health Canada, PHAC or the INSPQ are providing to local public health authorities for public health adaptation. However, Public Health Directorate interviewees knew that the INSPQ had expertise on climate change and health and had resources available for them, and reach out to the INSPQ informally at times for information or advice.

A point of convergence between the Montreal and Estrie Public Health Directorates was interviewees' insistence that "public health happens on the ground, not in the office" (interviewee, Montreal Public Health Directorate). They argued public health adaptation must happen through collaboration and engagement between levels of government, and not through top-down enforcement of measures that do not fit the local context:

"It's always an arm wrestle between governmental organizations. It

happens with Health Canada, the [Quebec] Ministry [of Health and Social Services], they are too far from the ground" (interviewee, Public Health Directorate).

Another interviewee said in regards to climate change and health:

"I think there is plenty of expertise over there [referring to federal level], but really a lot. I think they're waiting just for this, to be invited into the field and I tell myself oh my god! We should work more with them" (interviewee, Public Health Directorate).

5.2. Intergovernmental relations for public health adaptation in Germany

5.2.1. Top-down German Government coordination and interactions

Within the German federal government, the Robert Koch Institute and the Germany Environment Agency are key actors in public health adaptation. The federal government establishes committees with stakeholders from all levels of government to coordinate climate change adaptation activities, following a common practice in German inter-governmental relations. The federal/Länder *Ständiger Ausschuss zur Anpassung an die Folgen des Klimawandels* (StA AFK) [standing committee for the adaptation to climate change impacts] meets twice a year, and was also established to coordinate and link their respective climate change adaptation activities and share information, although it is not health specific. Under the umbrella of the StA AFK, the *Arbeitsgruppe Gesundheitliche Anpassung an die Folgen des Klimawandels* [ad hoc working group on the health impacts of climate change] was founded in 2011 and meets once or twice per year (Fig. 2b). This committee is intended to ensure coherence between levels of government for climate change and health adaptation, and sometimes has specific tasks. For example, at the time of interviewing they were preparing a heat health action plan for Germany based on the WHO framework. One interviewee pointed to the challenges of developing such a plan at the national level in the context of both jurisdictional constraints and regional climate change impacts:

"This is also quite tricky from our point of view because we are nominated to organize this but from our point of view we are dealing also only for the national level, not for the regional and not for the local level. Because the regional and local level in Germany often say the national level is not allowed to give any restrictions or directions to ours. [...] We can only prepare a general framework on it, but not the local implementation. [...] we are not able to do this because Germany is so diverse and there might be some varied problems from Berlin to Stuttgart, from Stuttgart to Munich, from Munich to Cologne to Hamburg. [...] It doesn't make sense that this is provided by the national level" (interviewee, German Environment Agency).

This working group is the only annual intergovernmental platform for coordination identified in either case study at any jurisdictional level that is specifically for climate change adaptation and health. Otherwise, in Germany the *Länder Arbeitsgruppe Umweltbezogener Gesundheitsschutz* (LAUG) [Regional Committee of Environment and Health] includes representatives from environment or health institutions, administrative bodies, the national level, Länder level, and sometimes the local level, and frequently addresses climate change issues. The Robert Koch Institute also holds annual meetings with the Länder on public health issues, where climate change is sometimes discussed. *Kompetenzzentrum Klimafolgen und Anpassung* (KomPass) [Competence Centre on Climate Impacts and Adaptation] acts as a switchboard for cooperation within the national level and with the regional and local levels. The formalized platforms or mechanisms for coordination are shown in Fig. 2b within an institutional map in comparison to the Canadian case study. The German Environment Agency and Robert Koch Institute also co-wrote a framework of recommended actions for authorities in Germany on climate change and health, which

identifies gaps and further actions for ensuring coordination between the federal government and *Länder* (Robert-Koch Institut und Umweltbundesamt, 2013).

The Deutscher Wetterdienst (DWD) [German Meteorological Office] also has institutionalized information channels with all German *Länder* through administrative agreements that define the dissemination of the DWD's heat warnings, though ultimately it is up to each *Land* what actions, if any, they will take (for further information see the UBA information system evaluation (Capellaro and Sturm, 2015)).

Outside of these formalized channels for coordination, the German federal government makes resources generally available to sub-national governments. The German federal government provides information such as research, training, and brochures to sub-national public health authorities through the UBA, the Robert Koch Institute, and the DWD, along with ozone, UV and allergy warnings (see for example Tannich (2015)). The German Federal Ministry of Education and Research made a call for proposals to fund projects analyzing vulnerability to climate change, available to the *Länder* or local authorities (not health-specific, but local health authorities were eligible to apply). None of the local public health officers interviewed have attended the training or workshops because they are held in Berlin: "They do offer seminars or exchange programs or places to meet, but we don't use that as much because Berlin is far away" (interviewee, Public Health Office). Otherwise the federal government does not directly fund local authorities for public health adaptation. The German National Adaptation Strategy is also intended to serve as a framework for *Länder* or local adaptation strategies, but adaptation is voluntary.

German federal government interviewees raised the issue of federalism without prompting, and described it as positive for the independence of the *Länder* in adaptation and health, but constraining in terms of seeking harmonization of adaptation activities or setting specific restrictions or directions. For example:

"The infectious surveillance system in Germany works properly, but this system does not appear to work for non-communicable diseases, so we have sometimes difficulties to get the real data, morbidity or mortality data, which refer to the regional or local level. From the government or national level we do not have any authority or responsibilities to say immediately please send us your data" (interviewee, German Environment Agency).

5.2.2. Top-down Baden-Württemberg Government coordination and interactions

The relationship between the Baden-Württemberg health bodies (the Ministry of Social Affairs and Integration and State Public Health Office) and the Public Health Offices functions in a hierarchical manner where the Public Health Offices are informed and directed by legislation, frameworks or guidelines. Under the *Landesgesundheitsgesetz* [State Health Law], amended in 2015, each district in Baden-Württemberg is required to develop *Gesundheitskonferenzen* [health conferences] to promote coordination between institutions in the health system and other municipal institutions (Fig. 2). One local public health official then represents all the Public Health Offices at the *Landesgesundheitskonferenz* [State health conference]. At the time of interviewing, the topic of climate change had not yet been discussed at the *Landesgesundheitskonferenz*.

The Baden-Württemberg *Ministerium für Umwelt, Klima und Energiewirtschaft* (UM) [Ministry of the Environment, Climate Protection and the Energy Sector] developed the *Klimawandel und modellhafte Anpassung in Baden-Württemberg* (KLIMOPASS) [Climate Change and Exemplary Adaptation in Baden-Württemberg] program in 2010. The KLIMOPASS program consists of competitive funding for applied climate research and adaptation projects. The City of Stuttgart received funding to evaluate the city's heat warning system, working in partnership with the Public Health Office. To date no Public Health Offices have applied directly to the program, although they are eligible,

which interviewees suggest may be due to a lack of capacity prepare a proposal, lack of prioritisation or lack of awareness of the program. The Baden-Württemberg adaptation strategy was also a bottom-up process where every community could voice their concerns and best practices, although this was not health-specific.

The Baden-Württemberg State Public Health Office makes information, guidelines, brochures, heat warnings, statistics and training on public health issues stemming from climate change for the Public Health Offices, but these are not specific to climate change:

"It's not issues of climate change in general as I said, it's issues that come out of climate change. It may be the allergy issue, it may be the consequences of mosquitoes and the influx of tiger mosquitoes. It maybe be about a different pattern of infectious disease. It's indirect. So far, I'm not aware that we have been asked 'can you tell me about the consequences of climate change for ABC county.' So far that's not happening. We have to tell them, be aware, you have a problem here, you may have a problem, look at your homes for the elderly. That has been done. We provide them. That's not climate change again, but it's the consequences of climate change" (interviewee, State Public Health Office).

5.2.3. Local public health perspectives and bottom-up interactions

In Germany, upper-level coordination on climate change adaptation and health, for example between the State Public Health Office and the DWD or with the Baden-Württemberg UM, does not trickle down to the Public Health Offices, and the DWD and UM did not contact the interviewed Public Health Offices directly. The Public Health Office interviewees also said they rarely or never interact with the State Public Health Office on climate change and health issues.

Public Health Office interviewees rely on the State Public Health Office for public health information generally: "this is the first institution I contact when I have problems" (interviewee, Stuttgart Public Health Office). However, when it comes to climate change and health issues, one interviewee said they call the federal UBA for informal advice instead because they received better feedback than from the State Public Health Office. These types of informal interactions varied between the Local Public Health Office interviewees, where one said they contact the State Public Health Office or federal government with climate change and health questions frequently or every four to five weeks, depending on the issue, while another said they rarely interact with upper-level governments on climate change and health issues. Local public health interviewees in Stuttgart and Karlsruhe surmised they must seek out information or support themselves, since they did not see the State Public Health Office offering or engaging with them on public health adaptation: "It's not common that we [the authorities] are supplied with information, we need to find it ourselves" (interviewee, Public Health Office).

All of the German Public Health Office interviewees said they did not believe they can influence climate change adaptation activities or decisions of upper-level governments, though one said they tried:

"The state government, they say they have certain ideas or maybe they'd like to do something, and I raise my hand and say I could join in with a lot of expertise I have, and they say thank you but it doesn't get further than that" (interviewee, Public Health Office).

They are optimistic though that "theoretically I could influence it once they get to me, but I haven't yet" (interviewee, Public Health Office).

6. Discussion

Canada and Germany's federal systems have two distinct approaches to intergovernmental relations and coordination between levels of government for public health adaptation. The German federal-*Länder* government ad hoc working group on the health impacts of

climate change was the only identified formalized platform in either case study designed to ensure coherence between two levels of governments on climate change and health. This committee functions not just for policy coherence, but also for collaboration on climate change and health tasks such as the development of a heat health action plan framework. In Canada, the federal and provincial governments do not have institutionalized modes of coordination for public health adaptation, but they do actively interact on an *ad hoc* basis on projects such as federal government research contracts and funding undertaken by the INSPQ. The working group responsible for creating the Pan-Canadian Framework on Climate Change and Clean Growth, co-chaired by one federal and one provincial government representative, is an example of Canada's federal-provincial government diplomacy and bilateral agreements in intergovernmental relations, which often involve co-chaired committees (Cameron and Simeon, 2002). Otherwise we find intergovernmental relations for public health adaptation in Canada are often more informal and/or based on relationships between civil servants rather than elected officials. These findings suggest there is greater formalized coordination for public health adaptation between federal and regional levels of government in Germany than in Canada.

Conversely, the greater formalization of coordination for public health adaptation in Germany than in Canada is not mirrored in the relationship between regional governments and local public health authorities. We see little coordination of, or interactions for, public health adaptation between the Baden-Württemberg government and Public Health Offices, in contrast with the highly cooperative federal-Länder relationship. In Quebec meanwhile, the Public Health Directorates are considered clients in the provincial government's public health adaptation work, and climate change is discussed at least annually at the Quebec environmental health liaison table. These findings are surprising considering our expectations from federalism and intergovernmental relations theory (Hueglin and Fenna, 2015), but could be the result of adaptation being a relatively new policy issue, and the complex relationship between regional and sub-regional organizations (Phillimore, 2013). Once public health adaptation to climate change is established at each level of government, the need for coordination may become more pressing. Since regional governments in federal systems usually have authority for public health and over the local public health authorities, the regional-local relationship is particularly important for public health adaptation. Quebec is additionally the only sampled jurisdiction using hierarchy in intergovernmental relations for public health adaptation, by requiring Public Health Directorates to consider climate change in their Regional Action Plans and mandatory uptake of guidelines related to climate change and health. In contrast, like the two sampled Public Health Offices in Baden-Württemberg, Brodner et al. (2014) find German local public health authorities have not been tasked with climate change adaptation. Using hierarchy in intergovernmental relations for climate change adaptation involves moderate-high political risk, high resource intensiveness, and moderate-high ideological and financial constraints, thus outwardly demonstrating a strong commitment to climate change adaptation (Henstra, 2015).

Local public health interviewees in Germany concluded that it is up to the local level to take initiative from the bottom-up to get support from or work with upper level governments on climate change adaptation. Regional governments and local public health authorities were sometimes able to inform or influence upper-level public health adaptation activities through consultations, coordination tables, and informal discussions. The Montreal Public Health Directorate, for example, also had some of their heat strategy picked up by the federal and provincial governments for policy transfer to other regions. The German local public health authorities notably said they did not believe they could influence upper-level governments. The linkages between levels of government for public health adaptation were weakest where politics interfered (i.e., election of political parties with different priorities), where public health or adaptation coordination mechanisms did

not exist, and where local public health authorities were not included in upper-level governments' or municipalities' climate change adaptation activities.

The two federal systems examined in this study are at opposite ends of the federalism spectrum, and these differences are reflected in their approach to federal-regional coordination of public health adaptation. While intergovernmental relations is perhaps the most obviously relevant to coordination of public health adaptation between levels of government, the intergovernmental approach is shaped by a country's type of federalism and federation structure. Canada's institutional structure has influenced the emphasis on provincial autonomy and on the importance of informal relationships between civil servants in various levels of government for coordination of public health adaptation. In accordance with its loosely coupled system, climate change adaptation in the Canadian public health sector has proceeded between the federal and provincial governments using collaborative and non-coercive approaches, similar to other sectors (Henstra, 2017). The use of informal relationships between levels of government in Canada for adaptation has similarly been highlighted in other country contexts (Juhola and Westerhoff, 2011) and is found to be essential for learning and change by supporting innovative and creative thinking (Pahl-Wostl, 2009). In addition, competitive federalism and loose coupling in Canada stimulates for policy learning and experimentation suited to the context of climate policy (Brown, 2012). Federal and regional governments in Canada could consider establishing a dedicated climate change and health coordination platform, such as the working group in Germany. However, in the Canadian context, such a platform would likely be more effective if it is not overly formalized and if it maintains provincial autonomy. Germany's institutional structure, meanwhile, contributes to a high level of federal-Länder interaction and cooperation on public health adaptation. Under Germany's tightly coupled system policy experimentation may be more challenging; however, there is greater potential to use hierarchical means in the future to require sub-national public health adaptation across the whole country. German Länder may look to the Canadian province of Quebec for an example of a regional government using hierarchy and frameworks to ensure local public health adaptation. In federal systems, sub-national jurisdictions have significant autonomy over how they decide to implement or mainstream public health adaptation, so drivers other than top-down directives matter for adaptation, especially at the local-level.

7. Conclusion

The public health sector has a critical role to play in ensuring health is protected from climate change, but is faced with intergovernmental challenges in federal systems. There has been little discussion in the scientific literature on the regional-local relationship for climate change adaptation, which is a notable gap for federations where regions have significant policy authority. This paper aimed to gain insights into the ways intergovernmental relations are shaped and how different types of federalism influence coordination between levels of government. From theory we expected institutional structure to play an important role in coordination and intergovernmental relations for public health adaptation. We expected to find more formalized and top-down patterns of public health adaptation in Germany and more informal and bottom-up patterns in Canada. Our findings confirm our respective expectations on the federal-regional intergovernmental relationships in each country. We did not, however, find that for the relationships between regional governments and local public health authorities. Instead, we found that the provincial-local relationship in Quebec was hierarchical but with opportunities to collaborate, while in Baden-Württemberg the Länder and local public health authorities did not work together on public health adaptation to climate change. Different types of federalism matter for federal-regional government interactions on public health adaptation, but our findings suggest that other factors also play an important role, including dispersion of authority in regional public

health systems and the time needed to institutionalize new policy issues such as adaptation to climate change. Designing new multi-level co-ordination requires sensitivity to the type of federalism, yet lessons can be learned from other or similar types of federalism.

Conflict of interest

None.

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References

- Adam, M.-A., Bergeron, J., Bonnard, M., 2015. Intergovernmental relations in Canada: competing visions and diverse dynamics. In: Poirier, J., Saunders, C., Kincaid, J. (Eds.), *Intergovernmental Relations in Federal Systems: Comparative Structures and Dynamics*. Oxford University Press.
- Auerbach, C., Silverstein, L.B., 2003. *Qualitative Data: An Introduction to Coding and Analysis*. NYU Press.
- Austin, S.E., Ford, J.D., Berrang-Ford, L., Araos, M., Parker, S., Fleury, M.D., 2015. Public health adaptation to climate change in Canadian jurisdictions. *Int. J. Environ. Res. Public Health* 12, 623–651.
- Austin, S.E., Biesbroek, R., Berrang-Ford, L., Ford, J.D., Parker, S., Fleury, M.D., 2016. Public health adaptation to climate change in OECD countries. *Int. J. Environ. Res. Public Health* 13, 889.
- Aylett, A., 2015. Institutionalizing the urban governance of climate change adaptation: results of an international survey. *Urban Clim.* 14, 4–16.
- Bakvis, H., Brown, D., 2010. Policy coordination in federal systems: comparing inter-governmental processes and outcomes in Canada and the United States. *Publius J. Fed.* 40, 484–507.
- Banting, K.G., Corbett, S., 2002. Introduction. In: Banting, K.G., Corbett, S. (Eds.), *Health Policy and Federalism: A Comparative Perspective on Multi-Level Governance*.
- Bauer, A., Steurer, R., 2014. Multi-level governance of climate change adaptation through regional partnerships in Canada and England. *Geoforum* 51, 121–129.
- Bauer, A., Feichtinger, J., Steurer, R., 2012. The governance of climate change adaptation in 10 OECD countries: challenges and approaches. *J. Environ. Policy Plan.* 14, 279–304.
- Benz, A., 2000. Two types of multi-level governance: intergovernmental relations in German and EU regional policy. *Reg. Fed. Stud.* 10, 21–44.
- Benz, A., 2007. Inter-regional competition in co-operative federalism: new modes of multi-level governance in Germany. *Reg. Fed. Stud.* 17, 421–436.
- Benz, A., Eberlein, B., 1999. The Europeanization of regional policies: patterns of multi-level governance. *J. Eur. Public Policy* 6, 329–348.
- Bernier, N.F., 2006. Quebec's approach to population health: an overview of policy content and organization. *J. Public Health Policy* 27, 22–37.
- Berry, P., Richardson, G.R.A., 2016. Approaches for building community resilience to extreme heat. In: Steinberg, S.L., Sprigg, W.A. (Eds.), *Extreme Weather, Health, and Communities*. Springer, Switzerland.
- Bierbaum, R., Smith, J.B., Lee, A., Blair, M., Carter, L., Chapin, F.S., Fleming, P., Ruffo, S., Stults, M., Mcneely, S., Wasley, E., Verdusco, L., 2013. A comprehensive review of climate adaptation in the United States: more than before, but less than needed. *Mitig. Adapt. Strateg. Glob. Change* 18, 361–406.
- Blank, R.H., Burau, V., 2014. *Comparative Health Policy*, 4th ed. Palgrave Macmillan, London, United Kingdom.
- Bolleyer, N., Börzel, T.A., 2010. Non-hierarchical policy coordination in multilevel systems. *Eur. Polit. Sci. Rev.* 2, 157–185.
- Bowen, K.J., Ebi, K., Friel, S., McMichael, A.J., 2013. A multi-layered governance framework for incorporating social science insights into adapting to the health impacts of climate change. *Glob. Health Action* 6. <https://doi.org/10.3402/gha.v6i0.21820>.
- Brodner, B., Hornberg, C., Steinkühler, N., Keydel, A., McCall, T., 2014. Kommunale Strukturen, Prozesse und Instrumente zur Anpassung an den Klimawandel in den Bereichen Planen, Umwelt und Gesundheit: Ist Klimaanpassung im Öffentlichen Gesundheitsdienst kommunaler Praxis angekommen? Universität Bielefeld, Bielefeld, Deutschland.
- Brown, D.M., 2012. Comparative climate change policy and federalism: an overview. *Rev. Policy Res.* 29, 322–333.
- Burgess, M., 2006. *Comparative Federalism: Theory and Practice*. Routledge.
- Cameron, D., Simeon, R., 2002. Intergovernmental relations in Canada: the emergence of collaborative federalism. *Publius* 32, 49–72.
- Capellaro, M., Sturm, D., 2015. Evaluation of Information Systems Relevant to Climate Change and Health - Vol. 1. In: *UMWELTBUNDESAMT* (ed.). Umweltbundesamt.
- Chisholm, D., 1992. *Coordination Without Hierarchy: Informal Structures in Multiorganizational Systems*. Univ. of California Press.
- Clar, C., Steurer, R., 2014. Mainstreaming climate change adaptation in a federal state setting: policy changes in the flood protection and tourism sectors in Austria? *Aust. J. Polit. Sci.* 43, 23–47.
- Costello, A., Abbas, M., Allen, A., Ball, S., Bell, S., Bellamy, R., Friel, S., Groce, N., Johnson, A., Kett, M., Lee, M., Levy, C., Maslin, M., McCoy, D., McGuire, B., Montgomery, H., Napier, D., Pagel, C., Patel, J., Antonio, J., De Oliveira, P., Redclift, N., Rees, H., Rogger, D., Scott, J., Stephenson, J., Twigg, J., Wolff, J., Patterson, C., 2009. Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission. *Lancet* 373, 1693–1733.
- Dannevig, H., Aall, C., 2015. The regional level as boundary organization? An analysis of climate change adaptation governance in Norway. *Environ. Sci. Policy* 54, 168–175.
- Dicey, A.V., 1893. *Introduction to the Study of the Law of the Constitution*. London, New York, Macmillan.
- Dickinson, T., Burton, I., 2011. Adaptation to climate change in Canada: a multi-level mosaic. In: Ford, J.D., Berrang-Ford, L. (Eds.), *Climate Change Adaptation in Developed Nations*. Springer, Dordrecht, The Netherlands.
- Egeberg, M., Trondal, J., 2016. Why strong coordination at one level of government is incompatible with strong coordination across levels (and how to live with it): the case of the European Union. *Public Adm.* 94, 579–592.
- Elazar, D.J., 1987. *Exploring Federalism*. University of Alabama Press.
- Farber, D.A., 2011. Issues of scale in climate governance. In: Dryzek, J.S., Norgaard, R.B., Schlosberg, D. (Eds.), *The Oxford Handbook of Climate Change and Society*. Oxford University Press, Oxford.
- Fenna, A., 2012. Federalism and intergovernmental coordination. In: Peters, B.G., Pierre, J. (Eds.), *The SAGE Handbook of Public Administration*, 2nd ed. SAGE, London.
- Fidelman, P.I.J., Leitch, A.M., Nelson, D.R., 2013. Unpacking multilevel adaptation to climate change in the Great Barrier Reef, Australia. *Glob. Environ. Change* 23, 800–812.
- Fierlbeck, K., 2010. Public health and collaborative governance. *Can. Public Adm.* 53, 1–19.
- BUNDESAMT FÜR KARTOGRAPHIE UND GEODÄSIE 2017. Administrative areas 1:250,000 - Stand 01.01.2017.
- German Federal Government, 2011. *Adaptation Action Plan of the German Strategy for Adaptation to Climate Change*.
- Glicksman, R.L., 2010. Climate change adaptation: a collective action perspective on federalism considerations. *Environ. Law* 40, 1159.
- Gosselin, P., Bélanger, D., Lapaige, V., Labbé, Y., 2011. The burgeoning field of trans-disciplinary adaptation research in Quebec (1998–): a climate change-related public health narrative. *J. Multidiscip. Healthc.* 4, 337.
- Government of Canada, 2016a. *Pan-Canadian Framework on Clean Growth and Climate Change*.
- Government of Canada, 2016b. *Working Group on Adaptation and Climate Resilience: Final Report*. Government of Canada, Gatineau, QC.
- Groupe de travail ad hoc sur les inondations, 2015. *Inondations: guide d'intervention à l'intention des intervenants de santé environnementale*. INSPQ.
- Hanssen, G.S., Mydske, P.K., Dahle, E., 2013. Multi-level coordination of climate change adaptation: by national hierarchical steering or by regional network governance? *Local Environ.* 18, 869–887.
- Health Canada, 2011a. *Communicating the Health Risks of Extreme Heat Events. In: WATER AIR AND CLIMATE CHANGE BUREAU* (ed.). Ottawa, ON.
- Health Canada, 2011b. *Extreme Heat Events Guidelines: Technical Guide for Health Care Workers*. Health Canada, Ottawa, ON.
- Health Canada, 2011c. *Extreme Heat Events Guidelines: User Guide for Health Care Workers and Health Administrators*. Health Canada, Ottawa, ON.
- Health Canada, 2012. *Heat Alert and Response Systems to Protect Health: Best Practices Guidebook*. Healthy Environments and Consumer Safety Branch, Ottawa, ON.
- Helmke, G., Levitsky, S., 2004. Informal institutions and comparative politics: a research agenda. *Perspect. Politics* 2, 725–740.
- Henstra, D., 2015. The tools of climate adaptation policy: analysing instruments and instrument selection. *Clim. Policy* 1–26.
- Henstra, D., 2017. Climate adaptation in Canada: governing a complex policy regime. *Rev. Policy Res.* n/a/n/a.
- Hess, J.J., McDowell, J.Z., Luber, G., 2012. Integrating climate change adaptation into public health practice: using adaptive management to increase adaptive capacity and build resilience. *Environ. Health Perspect.* 120, 171.
- Hooghe, L., Schakel, A.H., Marks, G., 2008. Appendix B: country and regional scores. *Reg. Fed. Stud.* 18, 259–274.
- Hooghe, L., Marks, G., Schakel, A.H., Osterkat, S.C., Niedzwiecki, S., Shair-Rosenfield, S., 2016. *Measuring Regional Authority: A Postfunctional Theory of Governance*. Oxford University Press.
- Hueglin, T.O., Fenna, A., 2015. *Comparative Federalism: A Systematic Inquiry*. University of Toronto Press.
- Juhola, S., Westerhoff, L., 2011. Challenges of adaptation to climate change across multiple scales: a case study of network governance in two European countries. *Environ. Sci. Policy* 14, 239–247.
- Kern, K., Alber, G., 2008. *Governing Climate Change in Cities: Modes of Urban Climate Governance in Multi-Level Systems*. Competitive Cities and Climate Change (OECD), Milan, Italy, pp. 171–196.
- Keskitalo, E.C.H. (Ed.), 2010. *Developing Adaptation Policy and Practice in Europe: Multi-Level Governance of Climate Change*. Springer, Dordrecht, The Netherlands.

- Keskitalo, E.C.H., 2010b. Introduction – adaptation to climate change in Europe: theoretical framework and study design. In: Keskitalo, E.C.H. (Ed.), *Developing Adaptation Policy and Practice in Europe: Multi-Level Governance of Climate Change*. Springer, Dordrecht, The Netherlands.
- Keskitalo, E.C.H., Westerhoff, L., Juhola, S., 2012. Agenda-setting on the environment: the development of climate change adaptation as an issue in European states. *Environ. Policy Gov.* 22, 381–394.
- Klein, J., Juhola, S., 2018. The influence of administrative traditions and governance on private involvement in urban climate change adaptation. *Rev. Policy Res.* 0.
- Koch, I.C., Vogel, C., Patel, Z., 2007. Institutional dynamics and climate change adaptation in South Africa. *Mitig. Adapt. Strateg. Glob. Change* 12, 1323–1339.
- Landesgesundheitsamt Baden-Württemberg, n.d. *Gesundheitsämter der Stadt- und Landkreise* [Online]. Available: https://www.gesundheitsamt-bw.de/lga/DE/Startseite/OEGD_BW/Gesundheitsaemter/Seiten/default.aspx [Accessed December 18 2016].
- Lang, A., 2015. Germany. In: Fierlbeck, K., Palley, H.A. (Eds.), *Comparative Health Care Federalism*. Ashgate Publishing, Ltd.
- Lemmen, D.S., Warren, F.J., Lacroix, J., Bush, E., 2008. From Impacts to Adaptation: Canada in a Changing Climate 2007. Natural Resources Canada, Government of Canada, Ottawa, ON.
- Lesnikowski, A., Ford, J., Berrang-Ford, L., Paterson, J., Barrera, M., Heymann, S., 2011. Adapting to health impacts of climate change: a study of UNFCCC Annex I parties. *Environ. Res. Lett.* 6.
- Magnan, A.K., Schipper, E.L.F., Burkett, M., Bharwani, S., Burton, I., Eriksen, S., Gemenne, F., Schaar, J., Ziervogel, G., 2016. Addressing the risk of maladaptation to climate change. *Wiley Interdiscip. Res. n/a-n/a*.
- Maioni, A., 2002. Federalism and health care in Canada. In: Banting, K.G., Corbett, S. (Eds.), *Health Policy and Federalism: A Comparative Perspective on Multi-Level Governance*.
- Marks, G., Hooghe, L., Schakel, A.H., 2008. Measuring regional authority. *Reg. Fed. Stud.* 18, 111–121.
- Mätzke, M., 2013. Federalism and decentralization in German Health and Social Care Policy. In: Costa-Font, J., Greer, S.L. (Eds.), *Federalism and Decentralization in European Health and Social Care*. Palgrave-Macmillan.
- McMichael, A., Neira, M., Bertollini, R., Campbell-Lendrum, D., Hales, S., 2009. Climate change: a time of need and opportunity for the health sector. *Lancet (London, England)* 11, 2123.
- OECD, 2014. *Regional Economy*.
- Pahl-Wostl, C., 2009. A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Glob. Environ. Change* 19, 354–365.
- Peters, B.G., 2015. *Pursuing Horizontal Management: The Politics of Public Sector Coordination*. University Press of Kansas Lawrence, KS.
- Peters, B.G., Pierre, J., 2001. Developments in intergovernmental relations: towards multi-level governance. *Policy Polit.* 29, 131–136.
- Phillimore, J., 2013. Understanding intergovernmental relations: key features and trends. *Aust. J. Public Adm.* 72, 228–238.
- Poirier, J., Saunders, C., 2015. Comparative experiences of intergovernmental relations in federal systems. In: Poirier, J., Saunders, C., Kincaid, J. (Eds.), *Intergovernmental Relations in Federal Systems: Comparative Structures and Dynamics*. Oxford University Press.
- Quebec, G. O. 2016. *An Act Respecting Health Services and Social Services, CQLR c S-4.2*.
- Robert-Koch Institut und Umweltbundesamt, 2013. *Klimawandel und Gesundheit: Allgemeiner Rahmen zu Handlungsempfehlungen für Behörden und weitere Akteure in Deutschland*. BMG und BMU.
- Scharpf, F.W., 1978. Interorganizational policy studies: issues, concepts and perspectives. In: Hanf, K., Scharpf, F.W. (Eds.), *Interorganizational Policy Making: Limits to Coordination and Central Control*. SAGE Publications, London and Beverly Hills.
- Séguin, J., 2008. *Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity*. Health Canada, Ottawa, ON.
- Simeon, R., Swinton, K., 1995. Introduction: rethinking federalism in a changing world. In: Knop, K., Ostry, S., Simeon, R., Swinton, K. (Eds.), *Rethinking Federalism: Citizens, Markets, and Governments in a Changing World*. UBC Press, Vancouver, CA.
- Smith, K.R., Woodward, A., Campbell-Lendrum, D., Chadee, D.D., Honda, Y., Liu, Q., Olwoch, J.M., Revich, B., Sauerborn, R., 2014. Human health: impacts, adaptation, and co-benefits. In: FIELD, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R., White, L.L. (Eds.), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Statistics Canada, 2011. *Boundary Files, 2011 Census (92-160-X)*.
- Statistics Canada, 2015. *Health Regions: Boundaries and Correspondence With Census Geography (82-402-X)*.
- Statistics Canada, 2016. In: Statistics Canada (Ed.), *Population and Dwelling Count Highlight Tables, 2011 Census*. Ottawa, Canada.
- Statistisches Landesamt Baden-Württemberg, 2015. *Eckdaten zur Bevölkerung*.
- Statistisches Bundesamt, 2015. *Population Based on the 2011 Census*.
- Steurer, R., Clar, C., 2018. The ambiguity of federalism in climate policy-making: how the political system in Austria hinders mitigation and facilitates adaptation. *J. Environ. Policy Plan.* 20, 252–265.
- Tannich, E. 2015. *Auswirkungen des Klimawandels auf die Verbreitung krankheitsübertragender Tiere: Importwege Und Etablierung Invasiver Mücken In Deutschland*. In: *UMWELTBUNDESAMT* (ed.). Umweltbundesamt.
- Toutant, S., Gosselin, P., Bélanger, D., Bustinza, R., Rivest, S., 2011. An open source web application for the surveillance and prevention of the impacts on public health of extreme meteorological events: the SUPREME system. *Int. J. Health Geogr.* 10, 39.
- Umweltbundesamt, 2014. *Erhebung Von Aktivitäten Und Maßnahmen Zu, Klimawandel Und Gesundheit*.
- Urwin, K., Jordan, A., 2008. Does public policy support or undermine climate change adaptation? Exploring policy interplay across different scales of governance. *Glob. Environ. Change* 18, 180–191.
- Warren, F.J., Lemmen, D.S., 2014. *Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation*. Government of Canada, Ottawa, ON.
- Wassenar, D., 2002. Federalism and the German health-care system. In: Banting, K.G., Corbett, S. (Eds.), *Health Policy and Federalism: A Comparative Perspective on Multi-Level Governance*.
- Watts, R.L., 1999. *Comparing Federal Systems*. McGill-Queen's University Press, Kingston, Ontario.
- Watts, N., Adger, W.N., Agnolucci, P., Blackstock, J., Byass, P., Cai, W., Chaytor, S., Colbourn, T., Collins, M., Cooper, A., Cox, P.M., Depledge, J., Drummond, P., Ekins, P., Galaz, V., Grace, D., Graham, H., Grubb, M., Haines, A., Hamilton, I., Hunter, A., Jiang, X., Li, M., Kelman, I., Liang, L., Lott, M., Lowe, R., Luo, Y., Mace, G., Maslin, M., Nilsson, M., Oreszczyn, T., Pye, S., Quinn, T., Svensdotter, M., Venevsky, S., Warner, K., Xu, B., Yang, J., Yin, Y., Yu, C., Zhang, Q., Gong, P., Montgomery, H., Costello, A., 2015. Health and climate change: policy responses to protect public health. *Lancet*.
- Westerhoff, L., Keskitalo, E.C.H., McKay, H., Wolf, J., Ellison, D., Botetzagias, I., Reyssat, B., 2010. Planned adaptation measures in industrialised countries: a comparison of select countries within and outside the EU. In: Keskitalo, E.C.H. (Ed.), *Developing Adaptation Policy and Practice in Europe: Multi-Level Governance of Climate Change*. Springer, Dordrecht, The Netherlands.
- Wilson, K., 2004. The complexities of multi-level governance in public health. *Can. J. Public Health/Revue Canadienne de Santé Publique* 95.
- Wright, D.S., 1974. Intergovernmental relations: an analytical overview. *Ann. Am. Acad. Pol. Soc. Sci.* 416, 1–16.